Non-linear dynamics of small quantum systems in ultrashort laser fields

L. A.A. Nikolopoulos [1]

School of Physical Sciences and NCPST, Dublin City University, Collins Ave, D9, Dublin, Ireland

In this talk I'll review the theoretical and computational approaches currently in use in our group for the ab-initio description of the dynamics of small quantum systems under intense electromagnetic fields [1-4]. Following this review I'll present some characteristic examples of our work for the cases of atomic hydrogen, neon and molecular hydrogen ion. Recently we have extended our methods to nano-sized systems such as the two-electron quantum dots under THz fields. I take this opportunity to discuss briefly our findings for this case as well.

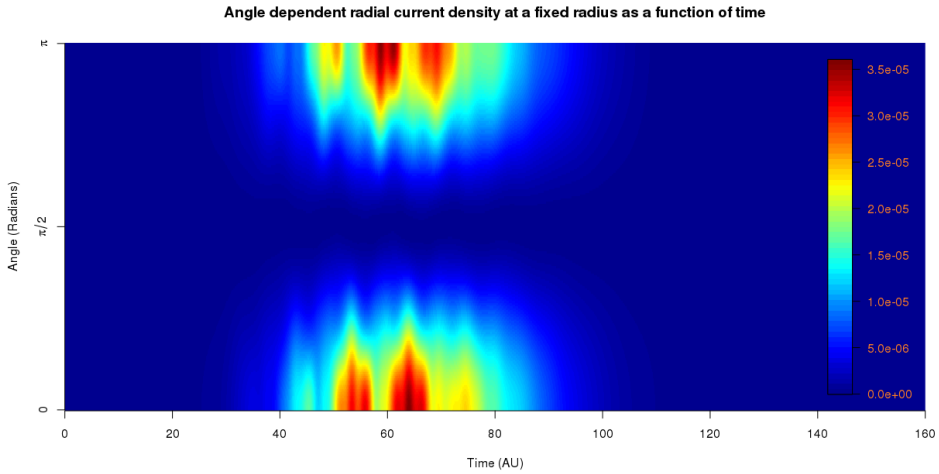

Figure 1: Electronic radial current probability density, $j_r(r_b, \theta, t)$, of the atomic hydrogen's time-dependent wave function at a fixed radius (r_b =6 a.u.) under a 10 cycles laser pulse, of peak intensity 10^{15}W/cm^2, carrier photon energy, 10 eV, of envelope sin^2 laser pulse. The electric field is linearly polarized along the z - axis ($\theta = 0^o$ direction).

References

[1] C. O' Broin and L. A.A. Nikolopoulos, *R-matrix-incorporating-time method for* H_2^+ in short and intense laser fields, Phys. Rev A, **92**, 063428, (2015)

[2] L. A. A. Nikolopoulos, J. S. Parker, and K. T. Taylor. Combined R-matrix eigenstate basis set and finite-difference propagation method for the time-dependent Schrodinger equation: The one-electron case. *Phys. Rev. A*, 78(6), 2008.

[3] L. R. Moore, M. A. Lysaght, L. A. A. Nikolopoulos, J. S. Parker, H. W. van derHart, and K. T. Taylor. *The RMT method for many-electron atomic systems in intense short-pulse laser light. J. Of Modern Optics*, 58(13, SI):1132–1140, 2011.

[4] M. A. Lysaght, L. R. Moore, L. A. A. Nikolopoulos, J. S. Parker, H. W. van der Hart, and K. T. Taylor. *Ab Initio Methods for Few- and Many-Electron Atomic Systems in Intense Short-Pulse Laser Light.* In Bandrauk, AD and Ivanov, M, editor, *Quantum Dynamic Imaging: Theoretical and Numerical Methods*, CRM Series in Mathematical Physics, 107-134. (2011).

[5] L. A.A. Nikolopoulos & Henri Bachau, *Size effects in the photoionization of two-electron quantum dots.* In preparation.

[1] E-mail: Lampros.Nikolopoulos@dcu.ie